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No. V.

*Memoir on Leaden Cartridges. By William Jones.—Read
March 15, 1811.*

THE awful catalogue of disasters, produced by the accidental explosion of gun powder, particularly on board ships of war, has been the subject of serious contemplation, and of earnest solicitude, for the discovery of an adequate remedy.

Naval and military history is replete with instances of the destruction of ships of war, and of military magazines, by accidents arising from the exposed and defective manner in which gun powder is kept; and particularly from the loose and combustible nature of *the common paper cartridge*: also of men killed and maimed in the act of reloading cannon, in consequence of the burning remnant of the paper cartridge, remaining in the chamber of the gun after the discharge.

Naval expeditions of the utmost importance are said to have failed, from the defective quality of the powder; damaged either by accident, or impaired by long exposure to the saline atmosphere, in the confined apartments on shipboard; and it is equally susceptible of injury from the humidity of a military magazine; as, in both cases, it is kept in casks, accessible to the action of the air.

The magazine of a ship of war, is a place that can be approached but with the greatest caution; and even under the

highest state of discipline and vigilance, frequent and fatal accidents occur.

Impressed with the importance of the subject, I conceived the idea of *substituting lead for paper* ; and in the year 1805, when at Canton in China, I caused to be made one hundred cartridges of thin sheet lead, with a portion of tin, to give it more tenacity.—One half were of six, and the other of four, pounder calibre ; I have yet remaining between 80 and 90.—The whole cost five dollars ; but if the order had been for a considerable quantity, the price would doubtless have been much reduced.

On my passage that year in the ship *Ploughboy*, from Canton to Philadelphia, I took an opportunity to make a fair experiment, and fired six rounds from a four pounder in quick succession, by instantly inserting the charge without spunging ; and then upon cleaning out the gun, I found only a small portion of lead, nearly of the size and form of mustard seed shot, and in quantity only sufficient to cover a surface of an inch square.

The lead cartridge may be perforated with as much ease as paper ; and as it is not necessary to ram home the charge, or prime the gun, until intended to be used, it may remain at all times in the gun, ready for service, without injury from wet or damp.

When ships of war take fire by any casualty, unless it can be instantly subdued, it becomes absolutely necessary to deluge the magazine ; for which purpose there is usually a stop-cock through the bottom of the ship : thus the whole of the powder on board may be rendered totally unfit for service, and of course the ship utterly defenceless. Whereas, if enclosed in lead, the powder would not sustain the least injury from the inundation.

The whole of the powder for a ship of war, may be filled in a perfect state, in the laboratory on shore ; and the aperture in the end of the cartridge, being closed with a cap of lead, secured by a cement of white lead, or other proper substance, will be impervious to moisture ; and thus the pow-

der may be preserved unimpaired in the state in which it was filled, for *any length of time*—an advantage of the utmost importance to the success of an enterprise.

The cartridges should be packed in cases, with cylindrical compartments fitted to the size of the several calibres; or with some soft substance to preserve them from injury or deformity; hence the necessity and the danger of filling the cartridges on board, in time of action, will be superseded.

If it shall be deemed necessary to have some larger packages of powder for ordinary or casual uses, the casks containing it, should be lined with thin lead, in *the manner of a tea chest*, and closed, like the cartridges, until required for use.

I think *cases* preferable to *casks*: their cubical form will occupy less space in proportion to their contents than casks; and about 50 pounds weight in each case, can be handled by one man with convenience.

As leaden cartridges will preserve their form better when full than empty, and will occupy only the same space, the whole of the ammunition should be filled in the laboratory, and the contents of each case distinctly marked with the number, calibre, and nature of the charges, whether full or reduced.

The increase of expense in substituting lead for paper cartridges, will be comparatively trifling, and will be amply remunerated, by the preservation of the quality, and saving in quantity, of the powder. For I believe when ships of war return from a cruize, their powder is generally sent to be remanufactured.

The preceding remarks are applied principally to naval service; but I conceive them to be equally applicable to many military purposes, particularly magazines, and even to field service, when rapid firing is necessary; for the charge may be instantly inserted without danger, as there is no necessity to sponge the gun, except when it may be necessary to cleanse or cool it.

We often hear of partizan detachments being frustrated in the object of their enterprise, by long exposure to heavy rains, or by fording deep streams, and thus damaging their powder. Why may not the cartridges of the infantry as well as the artillery, be formed of lead, *for particular objects ?**

The musket cartridge may be made as thin as paper, so that neither weight nor expense, can form an objection; and, when to be used, the end can be opened with the teeth, with as much facility as a paper cartridge.

The two cartridges now exhibited, contain a charge for a four pounder; and although they are of the size of a cylindrical powder measure for one pound weight, they are each made to contain nearly a pound and a quarter of powder, by gently striking the bottom on a table when filling, which serves the better to distend and support the sides of the cartridge.

One of them had a small neck about one-fifth of an inch high, and is closely corked and sealed with a cement of resin gum-mastic, and red lead; the other had merely a circular aperture closed with a cork, and over that a cap of lead, cemented with white lead—they have both *been completely immersed in water during the preceding forty-eight hours*. It is practicable to solder the cap; but, on trying the experiment, I found the degree of heat necessary to fuse solder, to approach so near to the ignition of gunpowder, that I think it would be found too hazardous in common practice.

It was my intention to have made this communication long since; but it has been delayed by the pressure of other pursuits, and partly by neglect. In the interval, I have occasionally conversed with several philosophical, naval, and military gentlemen, on this subject, who have all corroborated my views of the utility and importance of the object, and have

* Observe the difficulties that Pike and other travellers have experienced, from the effect of humidity upon their powder.

urged the communication which is now submitted with deference and respect to the American Philosophical Society, by

WM. JONES.

Philadelphia, March 15th, 1811.

This Memoir being referred to Messrs. Robert Patterson, T. Matlack and Joseph Cloud, to report thereon to the society: the author made a further communication on the subject to the committee, which, together with their report, was directed to be printed.

Philadelphia, March 22, 1811.

DEAR SIR,

As the only legitimate end of philosophical investigation is the discovery of truth, and as the truth can only be ascertained by a careful examination of facts, as they are developed in the progress of experiment, I deem it necessary to state to you, that after the exhibition of my leaden cartridges, (which had been immersed in water 48 hours) one of which was opened, and a part of the gun powder poured out perfectly dry, in the presence of the society at its last meeting—I emptied both the cartridges, and, contrary to my expectation, a part of the powder appeared in lumps *slightly adhesive*, but apparently dry. My first impressions were that a small degree of humidity must have penetrated through some imperceptible crevice, or that the low temperature of the water in which they had been immersed, had condensed the air within, and produced a slight degree of deliquescence, and consequent adhesion of the grains of powder: but, upon a more strict examination, I found the powder perfectly dry, and the interior of the cartridge equally so; not a grain of powder adhering to the corners, or the appearance of the least humid-

ity—then recollecting that I had packed the powder very hard, in order to distend and support the sides of the cartridge, it occurred to me that this must have been the cause of the adhesion. In order to satisfy myself on this head, I returned the powder into the cartridge, and packed it hard as before. Two days afterwards, I emptied it again, and found the powder in lumps slightly adhesive, exactly in the state first described; so that I am entirely satisfied that not the least moisture had passed through the cartridge, but that the powder and the interior of the cartridge were as perfectly dry after the immersion as before.

When the cartridges are filled and the caps cemented and dry, I would recommend a good coat of paint, in order to prevent oxidation, as well as to fill up any imperceptible crevice or defect in the cartridge. It is easy, however, to prove the soundness of the cartridge, by blowing in it to ascertain whether or not it is air tight.

I am of opinion, that very thin tin plate cartridges may be made to answer the same purpose, (in the absence of lead, which I think much preferable) provided they were well protected by a coat or two of paint, as tin will oxidate much sooner than lead.

Thin tin plate may readily be perforated by a slight stroke with a steel-pointed pricker.

I am very respectfully,

Yours,

WM. JONES.

*Messrs. Patterson, Cloud and Matlack,
Committee on Leaden Cartridges.*

The Committee to whom was referred the Memoir on Cannon Cartridges,

REPORT,

That the Committee have attentively considered *the Memoir on Cannon Cartridges*, presented to the society by Captain William Jones of this city, and are of opinion, that the experiments made by him fully demonstrate the utility of sheet-lead cartridges.

The security they will afford, against the danger from latent fire, so frequently retained by the cartridges now in use, and the time saved in scooping and spunging the cannon, which will be altogether unnecessary, are evidently of very great importance in the land service ; and, in addition to those advantages, that of securing gun powder at sea, from the destructive effects of moisture, extending even to the case of inundation of the powder-room, sometimes indispensibly necessary for the preservation of the ship ; they consider as being in the sea-service *inestimable*. Your Committee are therefore of opinion, that the communication is well worthy of a place in the transactions of the society.

And as practical improvements of this kind belong to the nation : your Committee therefore recommend, That the secretary of the society be directed to transmit to the secretary of the navy and the secretary at war of the United States, a copy of Captain Jones's Memoir. This, they conceive, ought not to be delayed, as sheet-lead of a size suitable for cannon cartridges not being in common use, time will be required for the necessary preparations for rolling it of that size. For a supply of an article of such importance in national defence, we ought not to depend on foreign nations ; and the readiness with which this can be manufactured within ourselves, at an expense, it is believed, that will not exceed the cost of flannel, or even paper cartridges, renders that dependence altogether unnecessary. How far the use of sheet

lead cartridges may, in some cases, be applied to musquetry, will of course present itself for consideration to the board of war of the United States;—and possibly that board may take into consideration the utility of preserving the whole stock of powder in their magazines in sheet-lead; either in cases or boxes lined with it.

R. PATTERSON, }
 T. MATLACK, } Committee.
 JOS. CLOUD, }

Copies of the Memoir and of the Report were transmitted as directed to the Secretary of War, from whom the following letter was received.

War Department, April 27th, 1811.

John Vaughan, Esq.

Librarian Am. Phil. Society.

Your letter of the 11th inst. inclosing a memoir on the advantages of using sheet-lead for cartridges instead of paper or flannel, has been received. The attention of the American Philosophical Society, to a subject so interesting as that of the preservation of powder, is equally honourable to them, and promising of usefulness to the public; and is observed (with suitable acknowledgments) by this department, to which it is peculiarly important.

Boxes or casks for keeping powder, lined with lead, are unquestionably applicable to all magazines constructed within or under walls of earth or masonry, or others, exposed to dampness or moisture; the introduction and use of leaden cartridges, however, must depend on further experience.

On the suggestion of an officer, a common tea-chest made of wood, and lined as usual with lead, was filled with powder.

The top, or mouth of the chest, was covered with pieces of board. It was buried in the earth in the month of November, 1809, where it remained until the month of May, 1810, when it was taken up. The powder was perfectly dry, excepting round the edges of the mouth, where it had been covered with the boards.

Respectfully, Sir,
Your obdt. servant,
W. EUSTIS.